Final Project Report to the NYS IPM Program, Agricultural IPM 2000 – 2001

Title:

Developing an IPM Response to a New Wheat Health Threat in New York: Wheat Soilborne Mosaic Virus

Project Leader(s):

Gary C. Bergstrom* (Plant Pathology, Ithaca), Mark E. Sorrells (Plant Breeding, Ithaca), Stewart M. Gray (USDA-ARS, Plant Pathology, Ithaca)

Cooperator(s):

Lance Davidson (Graduate Student, Plant Pathology, Ithaca); Mark Ochs (Consultant-Certified Crop Advisor, Trumansburg); Bruce Austic (Grain Producer, Trumansburg); Janice Degni (CCE Field Crops Specialist, Cortland); Michael Stanyard (CCE Field Crops Specialist, Newark); Stan Kawamoto (Research Support Specialist, Plant Pathology, Ithaca).

Type of grant:

Pest-resistant crops

Project location(s):

Throughout the Northeast

Abstract:

Soil infestation by a new virus, wheat soilborne mosaic virus (WSBMV), was recently confirmed in a localized area of the Finger Lakes region. The virus has the potential to reduce significantly the yield of New York winter wheat. A NYS-IPM supported project was initiated in 2000 with objectives to assess the current range of occurrence of WSBMV in New York, to assess its effect on wheat yield, and to identify adapted winter wheat varieties that are resistant to both SBWMV and wheat spindle streak mosaic virus (WSSMV), another soilborne virus that commonly infects New York wheat. Through cooperative survey with extension educators and seed industry personnel, WSBMV was confirmed during 2000 and 2001 in Cayuga, Schuyler, Seneca, Steuben, and Tompkins Counties on the wheat cultivars Harus, Marilee, Pioneer 25W33, and Caledonia. A WSBMV winter wheat cultivar nursery was established in an infested field in Trumansburg. An identical nursery was planted at Ithaca-Caldwell Field which has a history of WSSMV. Preliminary data on virus reactions of adapted cultivars were collected in 2000 and 2001. It appears that there is a broad range in virus reaction among New York-adapted cultivars. In cultivar selection, farmers should use only data summarized over multiple years. Cultivar nurseries for 2002 evaluation were planted at both the Trumansburg and Ithaca sites. Based on the 2000 and 2001 preliminary results, a proposal has been submitted to the NE-SARE program of USDA to secure funds for continuation of this project.

Background and justification:

Soft winter wheat for pastry flour is a very important cash crop for New York producers as it fits well into dairy, cash grain, and vegetable crop rotations and helps to disrupt the life cycles of pests that damage other predominant crops in these rotations. Rotation is the backbone of IPM for wheat in New York and helps to avoid yield losses incurred in wheat states where there is less frequent rotation. However, rotation is not a useful IPM strategy against certain diseases such as the soilborne viruses. The development and deployment of virus-resistant or virus-tolerant varieties is the most effective IPM strategy against these diseases.

For more than 20 years, a soilborne virus called wheat spindle streak mosaic virus (WSSMV) has been a yield-limiting factor in the production of winter wheat in New York. The disease is transmitted by a soilborne protozoan, *Polymyxa graminis*, which occurs as an obligate parasite of wheat roots in all soils in New York where wheat has once been grown. The vector and the virus persist in the soil for decades, ready to infect wheat seedlings the next time they are planted in an infested soil. Significant gains have been made in the last several years in identifying adapted varieties with partial resistance to WSSMV, and then educating wheat producers so these varieties are grown.

During 1998-99, a new soilborne virus called wheat soilborne mosaic virus (WSBMV) was for the first time confirmed to be present in at least three fields of winter wheat in northwestern Tompkins/southern Seneca Co. Statewide surveys in the 1980s showed the virus to be absent, suggesting fairly recent introduction. There is an urgent need to assess the geographic spread of this soilborne virus around the foci of infestations in Seneca, Schuyler, and Tompkins Counties and over broader areas of the state in order to determine where new IPM practices should be implemented. Producers with confirmed infestations have already been advised to practice sanitation and avoid moving infested soil to new locations. This virus produces similar symptoms to WSSMV and is also transmitted by *Polymyxa graminis* which is present throughout the state's wheat producing areas. Based on experience in other areas of North America where WSBMV occurs, this virus poses a significant risk to wheat production in New York.

Resistant varieties have been used successfully to diminish losses to WSBMV in other regions. Our challenge is that we have little information on the susceptibility/resistance of soft red and white wheat varieties that are adapted to New York. The severe infestation by WSBMV in a field in Trumansburg provides an opportunity to evaluate wheat varieties for resistance under natural conditions. By sowing the same varieties in a WSSMV-infested soil in Ithaca, we can supply New York growers with accurate recommendations on the specific resistance of varieties to each of the viruses in the soilborne virus complex. The multi-year objectives of this project include: 1) the determination of the current range of occurrence of WSBMV in New York soils, 2) assessment of the relative susceptibility/resistance of adapted, white and red winter wheat varieties and promising breeding lines to WSBMV and WSSMV, and 3) determination of the yield impact of WSBMV on yields of susceptible winter wheat.

Objectives:

1. Determine the current range of occurrence of WSBMV in New York soils.
2. Determine the impact of WSBMV on yields of susceptible winter wheat.
3. Assess the relative susceptibility/resistance of adapted, white and red winter wheat varieties and promising breeding lines to WSBMV and WSSMV.

Procedures:

Wheat fields near previously confirmed infestations were surveyed in April 2001 in cooperation with local CCE field crop specialists and seed industry personnel. Plants were collected from fields showing viral symptoms and these samples were analyzed by serological methods in the laboratory to confirm the presence of WSBMV. Extension field crop educators statewide were educated via the Internet (field crops listserve) as to the distinctive symptoms of WSBMV infection and were urged to submit suspect samples to plant pathology for analysis.

Replicated variety trials were planted in October 2000 in Trumansburg (WSBMV infested soil) and Ithaca Caldwell Field (WSSMV infested soil). Thirty-eight red wheats and 45 white wheats were evaluated. Plants were rated in May 2001 for visual symptoms of each virus. Representative plant samples were analyzed by serology (ELISA) in the lab for content of each virus.

Results and discussion:

Through visual inspection and serological assay, we confirmed that WSBMV is becoming increasingly prevalent in Cayuga, Schuyler, Seneca, Steuben, and Tompkins Counties. The majority of confirmed infections in 2001 were on the wheat variety Harus. It appears that not only is WSBMV more prevalent than we suspected but also the virus and vector may spread at a fairly high rate in the future. Expanded survey efforts in central and western New York counties are justified in April 2002.

In the variety nursery at Trumansburg we were able to observe some differences in varietal reaction to WSBMV. By planting the susceptible cultivar Harus throughout the nursery, we were able to observe a disease gradient in the nursery. This revealed a problem in our experimental design because we had planted all three replications of white wheats in an area with lower disease pressure; good ratings were obtained for red wheats under high disease pressure. We fixed our experimental design for the 2001-2 evaluations, and based on weather conditions after planting, we believe we will have a good opportunity for assessing resistance for all cultivars under high disease pressure. A preliminary summary of information on soilborne virus reaction in varieties that are currently recommended for planting in New York is provided in Table 1.

In a planting date study of resistant (Caledonia) and susceptible (Harus) check cultivars, we found that our assessments of these cultivars hold over diverse environments and hope to use this knowledge for a split-planter yield trial. We were unable to coordinate efforts with our collaborators to design and properly establish our split-planter experiment in 2000-1. However, the split-planter yield trials have been established for evaluation in 2002.

For the first time in over a decade of assessing resistance to WSSMV, no natural infection occurred. We attribute this to a dry post-planting soil environment in our nursery. However, despite the lack of data in 2000-1, we have accumulated resistance reaction data for all cultivars grown in New York.

Project goals and progress were featured at the Small Grains Management Field Day in June 2001. Preliminary results have been shared with wheat seed company and certified seed cooperative personnel as well as with Cornell extension educators. Based on the year 20001 preliminary results, a proposal has been submitted to the NE-SARE program of USDA to secure funds for continuation and expansion of this project.

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Table 1. Preliminary information on reaction of New York adapted wheat varieties to two soilborne viruses.

Cultivars:	***WSSMV Reaction*** (Ithaca, 2000 and previous) R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible	***WSBMV Reaction*** (Trumansburg, 2000 & 2001) R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible
SOFT WHITE WINTER WHEAT		
ACRon	MS	MS-MR
Caledonia	R	R
Cayuga	R	R
Geneva	R	R
Harus	MR	S
Marilee	MS	S
NYBatavia	MS	MR
Pioneer 25W33	R	MS
Superior	MS	R
SOFT RED WINTER WHEAT		
Freedom	MS	S
Mendon	R	MS
Pioneer 25R37	R	MS
WINTER TRITICALE		
Presto	R	S
RSI 815	R	MR
WINTER RYE		
Aroostook	R	MS
Puma	R	S
WINTER BARLEY		
Elmira	R	MR
McGregor	R	R

Information from Pioneer:	WSSMV rating (1-9) 1 = most suceptible 9 = most resistant	WSBMV rating (1-9) 1 = most suceptible 9 = most resistant
SOFT WHITE WINTER WHEAT		
Pioneer 25W33	7	4
Pioneer 25W60	7	7
SOFT RED WINTER WHEAT		
Pioneer 25R57	4	3
Pioneer 25R37	8	7